In the claims:

1. A non-invasive method for measuring the velocity of a free fluid surface flowing in a predetermined direction in an open channel or flume of a fixed shape comprising the steps of:

generating a microwave frequency electrical signal adapted to reflect from said fluid surface using a means to generate said electrical signal;

spacing the means to generate said electrical signal from said fluid surface;

directing said signal along a line toward the fluid surface and opposite the predetermined direction and at an angle of between 30 and 40 degrees to said fluid surface;

detecting the signal reflected from the fluid surface; and

determining from the directed and reflected signal the Doppler frequency shift therebetween as a measure of the velocity of the fluid surface.

2. The method of claim 1 wherein said directed signal forms a pattern on the fluid surface of an oval shape.

3. The method of claim 2 wherein said spacing is arranged so that said directed signal has an unobstructed cone-shaped view of the fluid surface.

4. The method of claim 3 wherein said spacing is generally between 18 and 48 inches.

5. The method of claim 1 comprising the additional steps of:

measuring the depth of the fluid in the channel or flume; and

determining from the velocity of the fluid surface and the depth of the fluid in the channel or flume, the flow rate of the fluid.

6. The method of claim 5 wherein the depth measurement is ultrasonically obtained.

7. The method of claim 6 wherein said ultrasonic measurement is non-invasive.

8. The method of claim 7 wherein said non-invasive method includes the steps of:

generating an ultrasonic acoustic signal adapted to reflect from said fluid surface using a means to generate said ultrasonic signal;

spacing the means to generate said ultrasonic signal a predetermined distance above the open channel or flume bottom and above the fluid surface;

directing said ultrasonic signal downwardly at said fluid surface;

detecting the ultrasonic signal reflected from the fluid surface; and

determining from the reflected ultrasonic signal the difference in length therebetween the open channel or flume bottom and fluid surface as a measure of the depth of the fluid in the open channel or flume.

9. A non-invasive method for measuring the velocity of a free fluid surface flowing in a predetermined direction in an open channel or flume of a fixed shape comprising the steps of:

generating an electrical signal adapted to reflect from said fluid surface using a means to generate said electrical signal;

spacing the means from said surface to generate said electrical signal from said fluid surface;

directing said signal along a line toward the fluid surface, wherein said signal has an unobstructed path to the fluid surface;

detecting the signal reflected from the fluid surface, wherein the reflected signal travels through an unobstructed path; and

determining from the directed and reflected signal the Doppler frequency shift therebetween as a measure of the velocity of the fluid surface.

10. The method of claim 9 wherein the signal is directed opposite the predetermined direction.

11. The method of claim 9 wherein the signal is directed at an angle of between 30 and 40 degrees to said fluid surface.

12. The method of claim 9 wherein the signal is of a microwave frequency.

13. A non-invasive method for continuously measuring the volumetric flow of a free liquid flowing in a predetermined direction in an open channel or flume of a predetermined shape and a predetermined cross-section comprising the steps of:

generating an electrical signal adapted to reflect from said liquid surface using a means to generate said electrical signal;

spacing the means to generate said electrical signal from said liquid surface;

directing said signal along a line through an unobstructed path toward said liquid surface;

detecting said signal reflected from said liquid surface;

determining from said directed and reflected signal a Doppler frequency shift therebetween as a measure of the velocity of said liquid surface;

measuring a depth of said liquid travelling through the channel at said predetermined cross-section; and

determining from the velocity of said liquid surface and the depth of said liquid a volumetric flow of said liquid.

14. The method of claim 13 wherein said depth is measured by determining the difference between a predetermined distance between a depth measuring signal source to a bottom of said channel and a distance measured from said depth measuring signal source to said liquid surface.

15. The method of claim 13 wherein said signal is directed at said liquid surface at a predetermined angle.